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Keeping an Investigative Eye on the Financial Pulse of a Company Using Data Analytics

Christie L. Comunale
David C. Hayes
*James H. Irving**

Introduction and Background

The exponential surge and availability of data have forever altered the business landscape. Nearly all professions are living in a data-driven world and must learn to navigate a tremendous influx of information. The accounting profession has made significant investments in emerging data analytics technologies, and now heavily incorporates data analytics in its business model, fundamentally changing the role of the practicing accountant. For the future accountant, expertise in the application of accounting rules and regulations is no longer sufficient. Strong data analysis skills also are critical to the continued competitiveness of the profession (Schneider et al., 2015; Dzuranin et al., 2018; Tysiac and Drew, 2018).

Evidence from academic and practitioner publications suggests that the accounting profession's knowledge and understanding of data analytics still lag behind the broader business community (e.g., Wang and Cuthbertson, 2015; Cohn, 2017). This trend is alarming because the Association of Certified Fraud Examiners (ACFE) cites data analytics as especially effective in fraud detection. Proactive data monitoring and analysis are among the most effective anti-fraud controls, and organizations that undertake proactive data analytic techniques experience frauds that are 33 percent less costly and detect frauds 1.5 times more quickly than organizations that do not monitor and analyze data for signs of fraud (ACFE, 2020).

Arguably, one reason data analytics is not utilized more in the accounting profession is because accounting practitioners may not feel particularly proficient in the use of data analytics or are unclear how to effectively employ these skills. Despite the efforts of university accounting programs to increase their offerings of data analytics courses and degree programs, there is mounting concern that accounting education is not moving quickly enough to meet the accounting profession's demand for these skills, and that the speed of prospective curriculum change will continue to be an issue (Friedman, 2016; Andiola et al., 2020).

Recent studies confirm that accounting programs are behind the data analytics "curve". Citing inadequate resources and a shortage of qualified faculty, only 23 percent of separately accredited accounting programs have fully implemented the new technology requirements issued by the AACSB (Andiola et al., 2020).[1] And while there is consensus that universities must incorporate data analytics into the accounting curriculum, there are differing views on the most effective approach as well as the appropriate level where data analytics should be covered (Ballou et al., 2018; Dzuranin et al., 2018). More specifically, unresolved questions include: "Should accounting programs integrate data analytics into existing accounting courses, develop a stand-alone data analytics course (or courses), or both?" and "Should accounting programs integrate data analytics at the undergraduate level, the graduate level, or both?"

In order to further gauge how the accounting profession is evolving with regard to data analytics, and to build on the recent survey evidence in Ballou et al. (2018), and Dzuranin et al. (2018), and Andiola et al. (2020), we conducted our own survey of accounting professionals. The survey was completed by current accounting professionals at all experience

[1] For accreditation in accounting, the AACSB's Accreditation Standard A5, Information Technology Skills and Knowledge for Accounting Graduates, requires that "accounting degree programs include learning experiences that develop skills and knowledge related to the integration of information technology in accounting and business" (AACSB, 2018, p. 27). Technology skills are similarly recognized in the AICPA Pre-Certification Core Competency Framework (AICPA, 2018), which defines a set of skills-based competencies needed by accounting students entering the profession. Data analytics skills are a significant part of this technology integration.

*The authors are, respectively, Research Professor of Accounting, Stony Brook University; and Professor and Associate Professor of Accounting, James Madison University.

levels, and representing all specializations, in both public accounting and private accounting.[2] Of our 458 survey respondents, 78 percent reported analyzing financial ratios and financial information in their current or previous accounting role(s). Survey respondents identified horizontal analysis (i.e., comparing the change in an account balance, financial statement subtotal, or financial ratio value across two or more years) as the most frequently used tool for completing data analysis tasks. Other tools and techniques utilized by survey respondents included ratio analysis, common-size analysis, related accounts analysis, and data visualization. Survey respondents also noted that their employers continue to make significant investments in data analytics training, tools, and technologies, and that data analysis skills are an expected competency in accounting practice at all experience levels and specializations.

Given the rapid ascent of data analytics and its critical importance to the future of the accounting profession, the purpose of this case study is to help bridge the gap between the data analysis skills of accounting students and the data analysis expectations of accounting employers. We have developed an educational case that serves to improve students' understanding of and proficiency with fundamental data analytic tools and techniques. Guided by instructional videos, and using real public company data as well as an assortment of data visualization graphs, students apply four data analytic tools and techniques – ratio analysis, common-size analysis, horizontal analysis, and related accounts analysis—to identify and investigate unusual and unexpected changes (financial pulses) in a company's financial statements. The case is designed for use at the undergraduate or graduate level and can be tailored to fit a variety of courses, including introductory accounting, intermediate accounting, auditing, forensic accounting, financial statement analysis, and corporate finance, as well as a stand-alone data analytics course.

Learning Objectives

The case seeks to improve students' proficiency in detecting unusual and unexpected changes (financial pulses) in financial statements—including trends, patterns, and relationships—by applying four data analytic tools:

a. Ratio analysis;
b. Common size (vertical) analysis;
c. Horizontal analysis;[3]
d. Related accounts analysis.

The Case

I. Case Background

You have recently been hired by our forensic and investigative accounting firm, Financial Statement Investigators (FSI). On the first day of your new job, you will begin by learning about 10 suggestions that can help hone your data analytics skills. You will then be given financial information for the company you have been hired to investigate (Company #1) and some additional industry data to use for comparison purposes.

II. Resources Available to Complete the Case

There are four items you will use to complete the case (two training videos, this Word file, and one Excel file). It is critically important that you watch the training videos in their entirety and review the notes in the remainder of this document before beginning your investigation. Once you complete these steps, you are ready to launch the Excel spreadsheet and begin the case. You will want to have this Word file accessible as you complete the case. You also may want to refer back to excerpts from one or both of the videos. Your individual password to open the Excel spreadsheet is provided in the training videos.[4]

You should watch the two training videos in the following order:

1. Data Analytics Training.wmv (22 minutes)
2. Suggested Data Analytics Approach.wmv (23 minutes)

[2] This survey was conducted at the beginning of 2021.
[3] The case provides multiple opportunities for students to increase their proficiency with horizontal analysis. However, we were unable to assess the efficacy of the horizontal analysis tool because it would have taken too much time for students in a pre-/post-test setting. The design of the pre-/post-tests was constrained to one year of data, whereas assessment of horizontal analysis requires two or more years of data.
[4] Links to download the Excel case file and the two training videos are provided in the teaching notes to the case.

These two training videos discuss the following 10 data analytics suggestions (DAS). For the case, assume the first three DAS have already been done for you.

DAS #1: Get as much data as possible, taking cost effectiveness into account.

DAS #2: Get industry data to compare to.

DAS #3: Verify data of odd items.

You will focus on the remaining seven data analytics suggestions.

DAS #4: Have prior expectations—get to know your firm and industries.

DAS #5: Be careful of scaling effects on graphs—especially if you are comparing more than one company.

DAS #6: Use the "Greater than X%" to quickly identify big (material) accounts.

DAS #7: Look at cost items [Cost of Goods Sold (COGS), Gross Profit (GP)] and earnings trends [Return on Sales (ROS)].

DAS #8: Look at related accounts.

- Receivables (Net) and Net Sales
- Accounts Payable, Inventory, and Cost of Goods Sold

DAS #9: Look at horizontal analysis (changes from year-to-year)—note that horizontal analysis is only valuable if the error affects two or more years.

DAS #10: Utilize ratios to help analyze common accounts.

III. Accounts to Analyze

Since investigating a complete set of financial statements is very involved and could take a very long time, we are asking you to analyze only the following seven accounts:

1. Receivables (Net)
2. Inventories
3. Accounts Payable
4. Common Stock
5. Retained Earnings
6. Net Sales
7. Cost of Goods Sold

You will analyze the above accounts for Company #1 over a 15-year period. The important skill you should gain from this case is to better understand the effects of errors on the financial statements and how to apply four data analytic tools (ratio analysis, common-size analysis, horizontal analysis, and related accounts analysis) to more easily identify potential errors.

IV. Strategy for Completing the 'Student_Answers' and 'Student_Answers_2' Worksheet Tabs

Step 1: Use the 'Co_1_Ratios' tab and look at the Net Income % (row 104) to see how sensitive the company is to changes in earnings.

Step 2: Use the 'Co_1_Ratios' tab and look at the common-sized balance sheet (rows 58 to 90) and income statement (rows 92 to 104) to get a feel for the company's trends. Try putting in various percentages in the "Show items greater than %" (cells C60 and C94) to see where the big accounts are. Start with 50%, then 25%, then 10% and so on. For an illustration of how accounting errors affect common-sized percentages and ratios, see the Error Example 1 below (this illustration also is reviewed in one of the training videos).

Step 3: Use the 'Co_1_Ratios' tab and look at the horizontal analysis for the balance sheet (rows 116 to 149) and income statement (rows 150 to 162). Try putting in various % in the "Show items greater than %" (cells C119 and C152) to see where the big accounts are. Start with 50%, then 25%, then 10% and so on. A good idea is to look at the Raw Data ('Co_1_Data' tab) at this point to see which year is causing the item (prior year decrease or current year increase).

Step 4: Use the 'Analysis' tab for graphic visualization of the accounts and ratios. The table below is a guide to the graphs you may want to view.

Ratio Analysis		Common-Size Analysis		Common-Size Analysis		Horizontal Analysis		Horizontal Analysis	
		Balance Sheet Items		Income Statement Items		Balance Sheet Items		Income Statement Items	
		% of Total Assets		% of Net Sales		% Changes over prior year		% Changes over prior year	
#	Ratio	#	ASSETS	#	Income Statement	#	Assets	#	Income Statement
2	Current Ratio	2	Receivables (Net)	1	Cost of Goods Sold	2	Receivables (Net)	1	Net Sales
3	Accounts Receivable Turnover	3	Inventories	2	Gross Profit	3	Inventories	2	Cost of Goods Sold
5	Inventory Turnover	6	Total Current Assets	10	NET INCOME (LOSS)	6	Total Current Assets	3	Gross Profit
8	Total Liabilities to Total Assets							11	NET INCOME (LOSS)
10	Cost of Goods Sold Ratio		LIABILITIES				LIABILITIES		
12	Return on Sales	13	Accounts Payable			13	Accounts Payable		
		19	Total Current Liabilities			19	Total Current Liabilities		
		22	TOTAL LIABILITIES			22	TOTAL LIABILITIES		
			STOCKHOLDERS' EQUITY				STOCKHOLDERS' EQUITY		
		25	Common Stock			25	Common Stock		
		27	Retained Earnings			27	Retained Earnings		

Step 5A: Of the 7 accounts you have been assigned to analyze, begin with the two accounts that do not have any related accounts (Common Stock and Retained Earnings).

- **Common Stock:** The common stock account is best to analyze by itself given the options available. Here is a list of data analytic tools to consider:

	Ratio Analysis		Common-Size Analysis		Common-Size Analysis		Horizontal Analysis		Horizontal Analysis	
			Balance Sheet Items		Income Statement Items		Balance Sheet Items		Income Statement Items	
			% of Total Assets		% of Net Sales		% Changes over prior year		% Changes over prior year	
Account	#	Ratio	#	ASSETS	#	Income Statement	#	Assets	#	Income Statement
Common Stock			25	Common Stock			25	Common Stock		

- **Retained Earnings:** The retained earnings account is best to analyze by itself, but you also can use the calculated amounts for Net Income (Loss) and the Return on Sales ratio. Here is a list of data analytic tools to consider:

	Ratio Analysis		Common-Size Analysis		Common-Size Analysis		Horizontal Analysis		Horizontal Analysis	
			Balance Sheet Items		Income Statement Items		Balance Sheet Items		Income Statement Items	
			% of Total Assets		% of Net Sales		% Changes over prior year		% Changes over prior year	
Account	#	Ratio	#	ASSETS	#	Income Statement	#	Assets	#	Income Statement
Retained Earnings	12	Return on Sales	27	Retained Earnings	10	NET INCOME (LOSS)	27	Retained Earnings	11	NET INCOME (LOSS)

Step 5B: Of the five remaining accounts you have been assigned to analyze, consider the related accounts.

- **Receivables (Net) and Net Sales:** Here is a list of data analytic tools to consider for receivables and net sales:

	Ratio Analysis		Common-Size Analysis		Common-Size Analysis		Horizontal Analysis		Horizontal Analysis	
			Balance Sheet Items		Income Statement Items		Balance Sheet Items		Income Statement Items	
			% of Total Assets		% of Net Sales		% Changes over prior year		% Changes over prior year	
Account	#	Ratio	#	ASSETS	#	Income Statement	#	Assets	#	Income Statement
	2	Current Ratio								
Receivables (Net)	3	Accounts Receivable Turnover	2	Receivables (Net)			2	Receivables (Net)		
			6	Total Current Assets			6	Total Current Assets		
Net Sales									1	Net Sales
					2	Gross Profit			3	Gross Profit
		Return on Sales - same as Net								
	12	Income in CS			10	NET INCOME (LOSS)			11	NET INCOME (LOSS)

- **Accounts Payable, Inventories, and Cost of Goods Sold:** Here is a list of data analytic tools to consider for accounts payable, inventories, and cost of goods sold:

	Ratio Analysis		Common-Size Analysis		Common-Size Analysis		Horizontal Analysis		Horizontal Analysis	
			Balance Sheet Items		Income Statement Items		Balance Sheet Items		Income Statement Items	
			% of Total Assets		% of Net Sales		% Changes over prior year		% Changes over prior year	
Account	#	Ratio	#	ASSETS	#	Income Statement	#	Assets	#	Income Statement
Accounts Payable	2	Current Ratio	13	Accounts Payable			13	Accounts Payable		
			19	Total Current Liabilities						
	8	Total Liabilities to Total Assets	22	TOTAL LIABILITIES						
Inventories	2	Current Ratio								
	5	Inventory Turnover	3	Inventories	1	Cost of Goods Sold	3	Inventories	2	Cost of Goods Sold
			6	Total Current Assets	2	Gross Profit	6	Total Current Assets	3	Gross Profit
					10	NET INCOME (LOSS)			11	NET INCOME (LOSS)
		Cost of Goods Sold Ratio -								
Cost of Goods Sold Expense	10	same as COGS in CS			1	Cost of Goods Sold			2	Cost of Goods Sold
					2	Gross Profit			3	Gross Profit
					10	NET INCOME (LOSS)			11	NET INCOME (LOSS)

V. Evaluating Your Case

'Student_Answers' worksheet tab: Your case grade will be determined by your responses on the Student_Answers tab (i.e., leave as "OK" or change to "Investigate"). Here is a screen shot of what you will be completing—note that this screen shot only shows seven years of data; however, you will complete it for all 15 years of data related to Company #1.

Account	1	2	3	4	5	6	7
Receivables (Net)	OK	OK	OK	OK	OK	OK	OK
Inventories	OK	OK	OK	OK	OK	OK	OK
Accounts Payable	OK	OK	OK	OK	OK	OK	OK
Common Stock	OK	OK	OK	OK	OK	OK	OK
Retained Earnings	OK	OK	OK	OK	OK	OK	OK
Net Sales	OK	OK	OK	OK	OK	OK	OK
Cost of Goods Sold	OK	OK	OK	OK	OK	OK	OK

'Student_Answers_2' worksheet tab: On the Student_Answers_2 tab, enter the accounts and the years for items you would want to investigate further. In addition, indicate which data analytic tools helped you identify these items. In the "Other Comments" column, briefly describe your reasoning for investigating the account/year. **Note that this tab is very important for keeping yourself organized and for supporting the responses on your Student_Answers tab.** Here is a screen shot of what you will be completing.

	I	I = I used this DA tool and it suggested to investigate the account	
	O	O = I used this DA tool and it did not suggest to investigate the account	
	Z	Z = I did not use this DA tool or it is not available	

Account	Year	Raw Data	Ratio	Common-Size	Horizontal	Related Accts	Industry	Other Comments (why you suggested to investigate the account for that year)

VI. Closing Comments

This case is to be completed without assistance from anyone else. Sharing answers or files is in direct violation of the Honor Code.

Upload your completed spreadsheet (file/save as your last name) to the Learning Management System assignment "Data Analytics Case" by the due date.

Error Example 1: How Accounting Errors Affect Common-Size Percentages and Ratios

	Account	Recorded Correctly	Recorded Incorrectly
	Cash	$ 100	$ 100
	Accounts Receivable	$ 150	$ 150
	Inventory	$ 250	$ 350
	Total Current Assets	$ 500	$ 600
	Land	$ 500	$ 500
	Total Assets	$ 1,000	$ 1,100
	Current Liabilities	$ 300	$ 300

Common-sized based on Total Assets

Account	Recorded Correctly	Recorded Incorrectly
Cash	10.0%	9.1%
Accounts Receivable	15.0%	13.6%
Inventory	25.0%	31.8%
Total Current Assets	50.0%	54.5%
Land	50.0%	45.5%
Total Assets	100.0%	100.0%
	30.0%	27.3%

Common-sized based on Net Sales

Account	Recorded Correctly	Recorded Incorrectly
Net Sales	100.0%	100.0%
Cost of Goods Sold	70.0%	60.0%
Gross Profit	30.0%	40.0%
Selling General & Admin	15.0%	15.0%
Other Expenses	5.0%	5.0%
Net Income	10.0%	20.0%

Current Ratio	Recorded Correctly	Recorded Incorrectly
Current Assets	1.67	2.00
Current Liabilities		
Inventory Turnover		
Cost of Goods Sold	2.80	1.71
Average Inventory		
Average # of Days to Sell Inventory		
365	130.36	212.92
Inventory Turnover		

Case Efficacy

To assess whether the case is effective in increasing students' knowledge of data analytic tools and techniques, we invited accounting students from a large, east coast university to complete the case during the Spring 2021 semester. To control for prior experience with these data analytic tools and techniques, we selected two accounting courses at very different academic levels. The first course was an undergraduate introductory financial accounting course, where presumably students had little-to-no exposure to data analytic tools and techniques prior to completing the case. The second course was a graduate financial statement and data analysis course, where presumably students had some degree of exposure to data analytic tools and techniques prior to completing the case. Together, 86 students participated in the study (45 undergraduate students and 41 graduate students). Each of the students signed a consent waiver agreeing to participate in the study.[5]

Students first completed a pre-test to establish their baseline level of knowledge with respect to the four data analytic tools. Next, the instructor reviewed the case study, and the due date were reviewed, and then students were given one week to complete the assignment outside of class time. At the end of the week, students submitted the case to the course management system and completed a post-test. Finally, students were debriefed on the study.[6]

Overall Assessment of Student Proficiency

The results presented in Table 1, Panel A, show that students participating in the study significantly increased their overall proficiency with the data analytic tools upon completion of the case ($p < 0.001$), improving from 57 percent accuracy on the pre-test to 70 percent accuracy on the post-test. Students significantly increased their proficiency with three of the four individual tools, with increases in performance ranging from an increase of 7 percentage points on both individual account analysis and common-size analysis to an increase of 37 percentage points on related accounts analysis. Although students improved their performance on ratio analysis by 2 percentage points, this small increase was not statistically significant. [See Table 1, pg. 523]

To assess whether the data analytics case was beneficial for students regardless of academic level, the sample of students participating in the study (N=86) was divided into two subsamples: (i) undergraduate students (N=45) and (ii) graduate students (N=41). The results for this partitioning of the full sample are presented in Panels B and C of Table 1, respectively. The results are similar to those presented in Panel A, with the exception of the common-size analysis. An increase in performance on the common-size analysis of 4 percentage points by undergraduate students is weakly significant ($p < 0.10$), while an increase in performance on the common-size analysis of 10 percentage points by graduate students is significant at $p < 0.01$. Across all data analytic tools, undergraduate students improved their performance by 15 percentage points (from 47 percent to 62 percent) and graduate students improved their performance by 12 percentage points (from 67 percent to 79 percent).

[5] This study was approved by the university's institutional review board.

[6] Pre-test and post-test quizzes were used to evaluate case efficacy. Two steps were taken to ensure validity of the pre-test and post-test measures. First, students were not notified that they would be completing either a pre-test or a post-test ahead of time. Second, the deadline for students to submit their cases expired before students were able to access and complete the post-test.

Comparison of Proficiency Gains between Undergraduate and Graduate Students

By purposely selecting two groups of students at very different points in their accounting coursework, we expected differences in proficiency gains between these two groups. The results for these group comparisons are presented in Table 2. Panel A compares the performance of undergraduate and graduate students on the pre-test. As expected, graduate students significantly outperformed undergraduate students overall and for each of the individual data analytic tools. Across all data analytic tools, this difference is 20 percentage points (67 percent for graduate students versus 47 percent for undergraduate students). Graduate students also significantly outperformed undergraduate students on the pre-test quiz on each of the four individual tools, ranging from an advantage of 10 percentage points on common-size analysis to an advantage of 27 percentage points on related accounts analysis. [See Table 2, pg. 525]

Panel B of Table 2 compares the performance of undergraduate and graduate students on the post-test. Again, as expected, graduate students significantly outperformed undergraduate students overall and for each of the individual data analytic tools. However, across all data analytic tools, the performance gap between groups has been reduced to 17 percentage points (79 percent for graduate students versus 62 percent for undergraduate students). Similarly, the performance gap between groups also shrinks for three of the four individual data analytic tools. The lone exception where the performance gap widens is the common-size analysis tool (a gap of 21 percent in the pre-test versus 27 percent in the post-test).

Students' Perceived Learning, Enjoyment, and Feedback

In the post-test, students were asked several supplementary questions about the case. Table 3 summarizes the student responses to these questions. First, students were asked to indicate whether they learned from and enjoyed the data analytics case. A 7-point Likert-type scale was used, with one representing "strongly disagree" and seven representing "strongly agree." When students answered the statement, "I learned more about data analytics by completing the case," their mean score was 6.0, and 83 of 86 students (96.5 percent) provided a rating from five to seven, a strong indication that they learned from this case. To test this statistically, the student responses were subsequently re-coded for analysis, with one equaling agree (responses five to seven) and 0 equaling disagree or neutral (responses one to four). A Chi-square test statistic of 74.4 ($p < 0.01$) provides a statistically significant indication that they learned more about data analytics by completing the case.[7] [See Table 3, pg. 526]

When students answered the statement, "I enjoyed the case," their mean score was 5.2 and 64 of 86 students (74.4 percent) provided a rating from five to seven (Chi-square = 20.5, $p < 0.01$), indicating that they also significantly enjoyed the data analytics case. When students answered the statement, "I would like more cases like this where I can apply what I have learned," their mean score was 5.4 and 67 of 86 students (77.9 percent) provided a rating from 5 to 7 (Chi-square = 26.8, $p < 0.01$), indicating that they found significant value in the real-world application of data analytic tools. Together, students' perceptions clearly indicate that they enjoyed working on the data analytics case and believe that the case improved their understanding of the data analytics tools and techniques. Additionally, students' perceived learning is validated by their actual performance on the case and by their pre-test to post-test improvements.

Finally, in the post-test, students also were given the opportunity to provide feedback related to the case. Of the 86 students who completed both the pre-test and post-test, 24 students (28 percent) provided feedback about the case, and responses are reflected in Table 4 as representative comments. Overall, the comments were extremely positive. The common theme among the positive comments was how valuable students found the case in applying data analytic tools they learned to a real-world setting. Of the 24 comments, four provided constructive criticism. The common theme among the constructive comments is a desire for step-by-step guidance on how to use the various data and visualizations to draw conclusions about which account balances or changes in account balances should be investigated. These constructive comments clearly illustrate how the shades of gray provided by the case help students to further develop critical thinking skills and reinforce that they must become more accustomed to solving problems with a tolerance for ambiguity. [See Table 4, pg. 527]

Conclusion

[7] Additionally, Table 3 shows that student responses to statements about each of the individual data analysis tools resulted in statistically significant differences at $p < 0.01$.

Data analytics is widely considered to be a critical, emerging component of accounting education. The results from our survey of current accounting professionals align with recent findings from academic research and the significant investments being made by accounting firms, confirming the undeniable importance of data analytics for students entering the accounting profession. The educational requires students to detect unusual and unexpected changes (financial pulses) in a company's financial statement accounts and financial ratios as well as utilize visualization techniques to evaluate, discern, and communicate which trends, patterns, and relationships should be further investigated.

We find that students significantly increased their proficiency with the data analytic tools introduced in the case. In addition, this finding is robust to two groups of students at different points in their accounting coursework. Results from follow-up questions on the post-test indicate that students learned from and enjoyed the data analytics case, while student comments reveal that they perceived it was a valuable learning experience. Collectively, this evidence suggests that the case provides an opportunity for students enrolled in accounting courses at all levels to enhance their data analytics skills.

References

American Institute of Certified Public Accountants. (2018). AICPA pre-certification core competency framework. Available at: https://www.aicpa.org/interestareas/accountingeducation/resources/corecompetency.html. Last accessed 6/29/2021.

Association to Advance Collegiate Schools of Business International. (2018). Eligibility procedures and accreditation standards for accounting accreditation. Available at: https://www.aacsb.edu/-/media/aacsb/docs/accreditation/accounting/standards-and-tables/2018-accounting-standards.ashx. Last accessed 6/29/2021.

Andiola, L. M., E. Masters, and C. Norman. (2020). Integrating technology and data analytic skills into the accounting curriculum: Accounting department leaders' experiences and insights. *Journal of Accounting Education* 50: 1–18.

Association of Certified Fraud Examiners. 2020 Report to the Nations. Available at: https://www.acfe.com/report-to-the-nations/2020. Last accessed 6/29/2021.

Ballou, B., D. L. Heitger, and D. Stoel. (2018). Data-driven decision-making and its impact on accounting undergraduate curriculum. *Journal of Accounting Education* 44: 14–24.

Cohn, M. (2017). Audit technology evolving quickly at Big Four. *Accounting Today* (November 17). Available at: https://www.accountingtoday.com/news/audit-technology-evolving-quickly-at-big-four-firms. Last accessed 6/29/2021.

Dzuranin, A. C., J. R. Jones, and R. M. Olvera. (2018). Infusing data analytics into the accounting curriculum: A framework and insights from faculty. *Journal of Accounting Education* 43: 24–39.

Friedman, T. L. (2016). Thank you for being late: An optimist's guide to thriving in the age of accelerations. New York, NY: Farrar, Strauss, and Giroux.

Schneider, G. P., J. Dai, D. J. Janvrin, K. Ajayi, and R. L. Raschke. (2015). Infer, predict, and assure: Accounting opportunities in data analytics. *Accounting Horizons* 29(3): 719–742.

Tysiac, K., and J. Drew. (2018). Accounting firms: The next generation. *Journal of Accountancy* 225(6): 3-9. Available at: https://www.journalofaccountancy.com/issues/2018/jun/next-generation-accounting-firms.html. Last accessed 6/29/2021.

Wang, T., and R. Cuthbertson. (2015). Eight issues on audit data analytics we would like researched. *Journal of Information Systems* 29(1): 155–162.

Table 1: Assessment of Data Analytics Proficiency

Panel A: All students (undergraduate and graduate) with a pre-test and post-test match

Tool	**N**	**Pre-test mean (std. dev)**	**Post-test mean (std. dev)**	**t-statistic**
All Data Analytic Tools	86	0.57 (0.16)	0.70 (0.16)	10.40***
Individual Account Analysis	86	0.87 (0.20)	0.94 (0.12)	4.00***
Ratio Analysis	86	0.67 (0.21)	0.69 (0.20)	1.09
Common-Size Analysis	86	0.49 (0.21)	0.56 (0.26)	2.98***
Related Accounts Analysis	86	0.22 (0.25)	0.59 (0.36)	9.24***

Panel B: Undergraduate students with a pre-test and post-test match

Tool	**N**	**Pre-test mean (std. dev)**	**Post-test mean (std. dev)**	**t-statistic**
All Data Analytic Tools	45	0.47 (0.14)	0.62 (0.16)	7.36***
Individual Account Analysis	45	0.79 (0.24)	0.89 (0.15)	3.48***
Ratio Analysis	45	0.62 (0.23)	0.65 (0.24)	0.78
Common-Size Analysis	45	0.39 (0.14)	0.43 (0.20)	1.52*
Related Accounts Analysis	45	0.09 (0.23)	0.50 (0.42)	6.26***

Table 1: Assessment of Data Analytics Proficiency (continued)

Panel C: Graduate students with a pre-test and post-test match

Tool	N	Pre-test mean (std. dev)	Post-test mean (std. dev)	t-statistic
All Data Analytic Tools	41	0.67 (0.10)	0.79 (0.11)	7.66***
Individual Account Analysis	41	0.96 (0.08)	0.98 (0.04)	2.65***
Ratio Analysis	41	0.72 (0.16)	0.74 (0.13)	0.80
Common-Size Analysis	41	0.60 (0.23)	0.70 (0.25)	2.64***
Related Accounts Analysis	41	0.36 (0.19)	0.68 (0.24)	7.64***

*, **, *** indicate statistical significance at a probability of <0.10, <0.05, and <0.01, respectively (one-tailed test).

Students were given pre-test and post-test quizzes on Data Analytic tools that accounting professionals indicated they use in the profession.

All Data Analytic Tools: This variable measures the composite correct percentage score for the following 4 data analytic tools (out of 42).

Individual Account Analysis: Students considered an erroneous journal entry and responded whether the error would overstate, understate, or have no effect on selected balance sheet and income statement accounts. This variable measures the correct percentage score on 13 items.

Ratio Analysis: Students considered an erroneous journal entry and responded whether the error would overstate, understate, or have no effect on selected liquidity, asset management, debt management, and profitability ratios. This variable measures the correct percentage score on six items.

Common-Size Analysis: Students considered an erroneous journal entry and responded whether the error would overstate, understate, or have no effect on the common-sizing of selected balance sheet and income statement accounts. This variable is a combined measure of the correct common-size balance sheet and common-size income statement scores. This variable measures the correct percentage score on 13 items.

Related Accounts Analysis: Students considered a list of seven accounts (balance sheet and income statement accounts). For each account, students were asked to choose what other balance sheet and/or income statement accounts they would want to simultaneously investigate. For example, students earned full credit for choosing to simultaneously investigate the cost of goods sold and inventory accounts alongside accounts payable. This variable measures the correct percentage score on 10 items.

Table 2: Comparison of Undergraduate and Graduate Student Performance

Panel A: *Comparison of undergraduate and graduate pre-test scores*

Tool	**Undergraduate (N = 45) pre-test mean (std. dev)**	**Graduate (N = 41) pre-test mean (std. dev)**	**t-statistic**
All Data Analytic Tools	0.47 (0.14)	0.67 (0.10)	7.63***
Individual Account Analysis	0.79 (0.24)	0.96 (0.08)	4.33***
Ratio Analysis	0.62 (0.23)	0.72 (0.16)	2.48**
Common-Size Analysis	0.39 (0.14)	0.60 (0.23)	5.33***
Related Accounts Analysis	0.09 (0.23)	0.36 (0.19)	5.89***

Panel B: Comparison of undergraduate and graduate post-test scores

Tool	**Undergraduate (N = 45) Post-test mean (std. dev)**	**Graduate (N = 41) Post-test mean (std. dev)**	**t-statistic**
All Data Analytic Tools	0.62 (0.16)	0.79 (0.11)	5.58***
Individual Account Analysis	0.89 (0.15)	0.98 (0.04)	3.80***
Ratio Analysis	0.65 (0.24)	0.74 (0.13)	2.34**
Common-Size Analysis	0.43 (0.20)	0.70 (0.25)	5.49***
Related Accounts Analysis	0.50 (0.42)	0.68 (0.24)	2.46**

Students were given pre-test and post-test quizzes on Data Analytic tools that accounting professionals indicated they use in the profession.

, * indicate statistical significance at a probability of <0.05 and <0.01, respectively (two-tailed test).

Table 3: Participant Responses to Supplementary Questions Provided on the Post-Test Quiz

Question	N	Mean	% of 5, 6, or 7 Responses[a]	Chi-Square statistic
I learned more about data analytics by completing the case.	86	6.0	96.5%	74.4***
I learned more about ratio analysis by completing the case.	86	5.4	89.5%	53.8***
I learned more about common-size analysis by completing the case.	86	5.7	88.4%	50.7***
I learned more about related accounts by completing the case.	86	5.9	91.9%	60.3***
I enjoyed the case.	86	5.2	74.4%	20.5***
I would like more cases like this where I can apply what I have learned.	86	5.4	77.9%	26.8***

Students were asked to respond to the above statements indicating the extent to which they agreed. Responses were measured on a 7-point Likert-type Scale using 1 = Strongly Disagree, 4 = Neutral, 7 = Strongly Agree.

[a] Students responses were re-coded as "1" ("agree" for responses of either 5, 6, or 7) or "0" (neutral/"disagree" for responses of 1, 2, 3, or 4) and tested against random chance (50 percent).

*** indicates statistical significance at a probability of <0.01 (two-tailed test).

Table 4: Feedback from Participants

Panel A: Representative undergraduate student comments

Positive Comments
I thought this case was really helpful in actually applying my skills I learned in class, but also getting a better understanding of them by basically applying them to a real-world example where it did not feel like a school assignment - it felt as if I were working in the real world.
This assignment was very helpful in expanding my knowledge and understanding the information we learned in class. I am very grateful I did this assignment.
Very enjoyable and interactive! I loved putting what I have learned into action.
I was skeptical at first, but I definitely had some fun and learned something new about data analytics.
I really liked how we got to have a real-world example where we applied our knowledge of DA and accounting.
Really enjoyed this assignment and learning about data analysis. Still a little confused on all of the logistics but would enjoy another assignment like this.
I found the assignment a little difficult at first, however, it began to make more sense along the way, and I definitely learned from it.
Really enjoyed related accounts and comparing to industry competitors.
Interesting and a good alternative to standard homework.
Comments Providing Constructive Criticism
I really enjoyed this case, it let me expand what I have learned in class and brought something new to me. Although I really liked the case itself, I was just a little confused on how it was supposed to teach us about the different analysis tools. I thought it did a great job with related accounts; I just am still confused on some of the analysis tools.
I think overall this was a very interesting case study however I do feel a little more guidance on the graphs would be helpful because sometimes I would over think them and get very confused and almost mess myself up. So maybe like a practice one with the graphs just so we are sure we are getting it right before we have to utilize it for a whole data case. Because I didn't have that much confidence that I was even applying the knowledge correctly.

Table 4: Feedback from Participants (continued)

Panel B: Representative graduate student comments

Positive Comments
I have already taken the AUD CPA exam and I think that skills used in this case would be beneficial to prepare students for studying for that exam. The skills are definitely really useful and doing more cases would be helpful.
Being able to use the tools we have been taught the last five years in a case has been helpful to see where I need to focus on improving my skills.
It was interesting to play around with the graphs and trying to find things that stood out. I think cases like this can help get us prepared for working with programs in the real world that we might not be familiar with originally.
I think doing something like this as an ongoing in-class exercise throughout the semester would have been fun and really beneficial.
I enjoyed this case! It was most helpful in understanding common-sized, horizontal, and especially the impact on ratios.
Comments Providing Constructive Criticism
I learned most about related account analysis; however, I still believe this causes the most confusion for me moving forward.
Information overload with the amount of options and tools available and sheer data to examine. Was not sure if there was a limit on what to investigate (i.e., would what I list to investigate have to be blatant or would less severe deviations in expectations be okay to list as well, concern with time and efficiency when listing items thinking about potential false flags wasting time of superior).